

Section 925JC — Traffic Signal Equipment

Uninterruptible Power System

A. Requirements

This specification shall be for a true-on-line, power conditioner and uninterruptible power system (UPS) with battery backup capability designed for transportation and traffic applications. The UPS shall be a totally microprocessor controlled and software driven power system. The inverter shall be in operation at all times supplying clean regulated power (both voltage and frequency) to all loads, at all times. The UPS system must be fully power factor corrected and fully functional with any type of auxiliary power generator. The UPS system shall be furnished and installed in conformance with the following specification.

System Example:

Techpower Developments Uninterruptible Power System (DBL 1000MX)

Internal 1-Port NetAgent II SNMP Card (CP504B)

Techpower Developments Hot-Swap Generator Bypass System

MK Battery Traffic Series AGM Battery Set (24HR3000S-MK)

All associated wiring and connectors

External Cabinet with side-mounted watertight receptacle for connecting to external generator with twist type plug

1. Operation:

- a. The UPS shall provide a minimum two (2) hours of full run-time operation for an –LED-only|| intersection (minimum 1000W/1000VA active output capacity, with 80% minimum inverter efficiency)
- b. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 0 milliseconds. The same maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.
- c. The UPS shall include a Manual Bypass Switch which provides capability to transfer the power service to disable the UPS and operate only from the power service or external generator provided.
- d. The UPS shall provide the user with 3-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) dry relay contact closures, available on a panel-mounted terminal block, rated at a minimum 120V/1A, and labeled so as to identify each contact.
 - 1) The first set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labeled or marked –On Batt.||
 - 2) The second set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labeled or marked –Low Batt.||
 - 3) The third set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labeled or marked –Timer.||
 - 4) Relay contact activation shall be annunciated on the front panel via a visual indication. This can be either discreet LED, or part of LCD screen, etc.
- e. Operating temperature for both the inverter/charger, power transfer relay and manual bypass switch shall be –37 °C (-35F) to +74 °C (+165 F)
- f. Both the Power Transfer Relay and Manual Bypass Switch shall be rated at 240VAC/30 amps, minimum
- g. The UPS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of 2.5 – 4.0 mV/ °C (5-8 F) per cell. The temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 3 meters (10 feet) of wire.
- h. Batteries shall not be recharged when battery temperature exceeds 50 °C (122 F) ± 3 °C (6 F)
- i. UPS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 60VAC to 148VAC.
- j. When utilizing battery power, the UPS output voltage shall be at the user-defined level +/-1%, pure sine wave output, ≤ 3% THD, 60Hz ± 3Hz.
- k. UPS shall be compatible with CALTRANS Model 332A Cabinets, Model 170E Controllers, Model 2070 Controllers and cabinet components for full time operation.

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- l. n. UPS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.
- m. In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer relay shall revert to the NC (and de-energized) state, where utility line power is connected to the cabinet.
- n. Recharge time for the battery, from —protective low-cutoff to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.
- o. UPS shall be equipped with Ethernet communications module and email notification capability for alerts.

2. Mounting/Configuration

NOTE: All references made to EIA rail or EIA 19I (482.6mm) rack shall conform to Electronic Industries Standards EIA-310-B, Racks, Panels, and Associated Equipment, with 10-32 —Universal Spacing threaded holes.

a. General

- 1) Inverter/Charger Unit shall be shelf-mounted or rack-mounted on a standard EIA 19I rack. If the inverter/charger is mounted inside the 332A Cabinet (Configuration 1), a shelf shall be provided that supports the weight of the unit.
- 2) Power Transfer Relay and Manual Bypass Switch shall be mounted on EIA rail.
- 3) All interconnect wiring shall be provided between Power Transfer Relay, Bypass Switch and Cabinet Terminal Service Block and shall be no less than 3 meters (9'10I) of UL Style 1015 CSA TEW with the following characteristics:
 - AWG Rating: 10 AWG
 - Stranding: 105 strands of 30 AWG tinned copper
 - Rating: 600 V, 105 °C, PVC Insulation
- 4) Relay contact wiring provided for each set of NO/NC relay contact closure terminals shall be a minimum of 3 meters (10 feet) of UL Style 1015 CSA TEW 18 AWG wire, same ratings as above, except 16 strands of 30 AWG tinned copper. Wiring shall be of adequate length for particular installation.
- 5) All necessary hardware for mounting (shelf angles, rack, etc) shall be included in the bid price of the UPS. All bolts/fasteners and washers shall meet the following requirements:
 - Screw type: Pan Head Phillips machine screw
 - Size and Thread pitch: 10-32
 - Material: 18-8 stainless steel (Type 316 stainless steel is acceptable as an alternate)
 - Washer: Use one flat washer (18-8 stainless steel) under the head of each 10-32 screw (provided that the screws are properly tightened, lock washers are unnecessary.)
 - Number of screws per hinge bracket: Minimum of six (6) screws per hinge bracket spaced evenly along bracket, with one screw near each end.
- 6) The entire UPS, including batteries, shall be installed inside an externally mounted cabinet.
- 7) External Cabinet
 - a) The External Cabinet shall be used for housing batteries and/or UPS, which includes inverter/charger unit, power transfer relay, manually operated bypass switch, any other control panels, and all wiring and harnesses.
 - b) The same Inverter/Charger, Power Transfer Relay and manually operated Bypass Switch that fits inside a typical fully equipped CALTRANS Model 332A Cabinet shall also be able to fit inside the externally mounted cabinet.
 - c) The External Cabinet shall be a NEMA 3R rated cabinet conforming to TEES, August 16, 2002 Chapter 7, Section 2-Housings for the construction and finish of the cabinet. The specific finish of the external cabinet shall match the finish of the 332A cabinet. Anti-Graffiti paint shall not be used. Two separate mounting installations shall be used. Refer to the project plans for the appropriate mounting installation.
 - i. *Mounting Installation Type A shall be typically used for installing at locations with existing 332 cabinet. This cabinet mounting installation shall attach the external cabinet to the left side of the 332 cabinet. Type A mounting installation shall use fasteners that meet the following requirements:*
 - *(Total of 8 bolts per cabinet with 2 flat washers per bolt and 1 K-lock nut per bolt) Cabinet mounting bolts shall be:*
 - *18-8 Stainless Steel Hex Head (Fully Threaded)*

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- 3/8" – 16 X 1"
*Washers shall be:
Designed for 3/8" bolt*
- 18-8 Stainless Steel 1" OD round flat type
- K-lock washer shall be:
- 18-8 Stainless Steel, Hex Nut Assembled with Free-Spinning Tooth Washer
- 3/8" – 16 Screw size

External Cabinet to 332A Cabinet couplings shall provide a conduit for power connections between the 332A Cabinet and External Cabinet. The couplings shall consist of three parts and meet the following requirements:

- 2" Nylon Insulated, Steel Chase Nipple
- 2" Sealing, Steel Locknut
- 2" Nylon Insulated, Steel Bushing

The external cabinet shall come provided with all bolts, washers, nuts and cabinet-cabinet coupler fittings provided, necessary for mounting the external cabinet to the 332A Cabinet.

- ii. *Mounting Installation Type B shall be typically used for locations where a new traffic controller cabinet and foundation are being installed. This cabinet installation shall provide the external battery cabinet as a base mount cabinet on the same foundation as the 332 cabinet. Connections between the cabinets shall be through conduit in the cabinet base. The external cabinet shall be installed in the same relationship as shown in figure 925-4 to the 332 cabinet. The external cabinet shall be installed so that it is centered on the 30 inch left side of the 332 cabinet.*
- d) The specific dimensions and details of the external battery cabinet shall be 56"H x 26"W x 14"D.
- e) Four shelves shall be provided. There shall be a minimum of 304.8mm (12") clearance between shelves. Each shelf shall be a minimum of 263.65mm (10.38") X 635.0mm (25.1"), and capable of supporting a minimum of 57kg (125 lbs.) Shelf edges shall be turned down on all four sides for support and to provide a flat top surface. Shelves shall be predrilled with EIA rail mounting holes. Shelves shall provide a vertical passageway for wiring in the rear of the cabinet on both the left and right.
- f) The bottom shelf shall be capable of being removed.
- g) The external cabinet shall be ventilated through the use of louvered vents, filter, and one thermostatically controlled fan as per TEES Chapter 7 Section 2-Housings.
- h) External cabinet fan shall be AC operated from the same line output of the Manual Bypass Switch that supplies power to the 332 Cabinet. A 2-position terminal block shall be provided on the fan panel, along with 3 meters (10 feet) of connected hookup wire.
- i) The door shall be attached to the cabinet through the use of either a continuous stainless steel piano hinge or four, two-bolts per leaf, hinges as per TEES Chapter 7 Section 2. The door shall use a padlock clasp or latch and lock mechanisms as described in the TEES, in order to lock the door.
- j) Two EIA angle rails, along with all necessary mounting hardware (4sets of 10-32 bolts and nuts with captive washers) shall be provided with the external cabinet (not installed) Rails shall be symmetric to allow for installation on either right or left sides of the cabinet. Mounting holes and bracket shall allow for EIA rail installation at any location in the external cabinet. The EIA mounting angle nominal thickness shall be either 0.1345 inch (3.4163mm) plated steel or 0.105 inch (2.667mm) stainless steel.
- k) EIA rail mounting bracket shall be of continuous, one-piece design bolted into the cabinet to provide adequate support for rail-mounted equipment.
- l) Pressed in, flush-head threaded screw posts shall be inserted into the front face of the cabinet enclosure top sill. These threaded posts shall be used to mount both the fan panel and the EIA rail-mounting bracket. The screw posts shall be #10-32 thread size stud 0.625 inches in length.

3. Maintenance, Displays, Controls and Diagnostics

- a. The UPS shall include a display and /or meter to indicate current battery charge status and conditions.
 - 1) The UPS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.

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- 2) The UPS shall include a 0 to 100% battery capacity LED indicator.
 - b. The UPS shall have lightning surge protection compliant with IEEE/ANSI C.62.41.
 - c. The UPS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.
 - d. The UPS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.
 - e. The UPS shall include a front-panel event counter display to indicate the number of times the UPS was activated and a front-panel hour meter to display the total number of hours the unit has operated on battery power. Both meters shall have push button resets.
 - f. Manufacturer shall include a set of equipment lists, operation and maintenance manuals, and board-level schematic and wiring diagrams of the UPS, and the battery data sheets. Manual shall conform to TEES August 16, 2002, Chapter 1, Section 1.2.4.2.
4. Battery System
- a. Individual batteries shall be:
 - 1) Voltage rating: 12V type
 - 2) Group size: 24 maximum
 - 3) Batteries shall be easily replaced and commercially available off the shelf.
 - b. Batteries used for UPS shall consist of 3 to 8 batteries with a cumulative minimum rated capacity of 240 amp-hours.
 - c. Batteries shall be certified by the manufacturer to operate over a temperature range of – 40 °C (-40F) to +74 °C (+165 F)
 - d. The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.
 - e. Batteries shall indicate maximum recharge data and recharging cycles.
 - f. Battery Harness
 - 1) Battery interconnect wiring shall be via two-part modular harness.
 - 2) Part I shall be equipped with red (+) and black (-) 30.48 cm (12 inches) cabling that can be permanently connected to the positive and negative posts of each battery. Each red and black pair shall be terminated into an Anderson Power Pole Connector or AMP Power Series Connector or equivalent style connector.
 - 3) Part II shall be equipped with the mating Power Pole style connector for the batteries and a single, insulated Power Pole style connection to the inverter/charger unit. Harness shall be fully insulated and constructed to allow batteries to be quickly and easily connected in any order to ensure proper polarity and circuit configuration.
 - 4) Power Pole style connectors may be either one-piece or two-piece. If a two-piece connector is used, a locking pin shall be used to prevent the connectors from separating.
 - 5) The length of the battery interconnect harness (Part II) shall be a minimum of 152.4 cm (60 inches) from the Inverter/Charger plug to the first battery in the string. The lateral length of the harness between battery connectors shall be a minimum of 30.48 cm (12 inches)
 - 6) All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, all of proper gauge with respect to design current and with sufficient strand count for flexibility and ease of handling.
 - 7) Battery terminals shall be covered and insulated with molded boots so as to prevent accidental shorting.

B. Fabrication

Refer to [Subsection 925.2.07.A.1](#) for controller cabinet minimum fabrication Specifications.

C. Acceptance

General Provisions 101 through 150. Each UPS shall be manufactured in accordance with a manufacturer Quality Assurance (QA) program. The QA program shall include two Quality Assurance procedures: (1) Design QA and (2) Production QA. The Production QA shall include statistically controlled routine tests to ensure minimum performance levels of UPS units built to meet this specification and a documented process of how problems are to be resolved. The manufacturer, or an independent testing lab hired by the manufacturer, shall perform Design Qualification Testing on new UPS system(s) offered, and when any major design change has been implemented on an existing design. A major design change is defined as any modification, material, electrical, physical or theoretical, that changes any performance characteristics of the system, or results in a different circuit configuration. Where a dispute arises in determining if a

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system is a new design or if the system has had a major design change, the State will make the final determination if Design Qualification Testing is required prior to production consideration.

Production Quality Control tests shall be performed on each new system prior to shipment. Failure to meet this requirements shall be cause for rejection. The manufacturer shall retain test results for seven years. Each UPS shall be given a minimum 100-hour burn-in period to eliminate any premature failures. Each system shall be visually inspected for any exterior physical damage or assembly anomalies. Any defects shall be cause for rejection.